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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/998,858	10/31/2001	Wen-Ben Chou	LAM2P295	6935

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MARTINE PENILLA & GENCARELLA, LLP
710 LAKEWAY DRIVE
SUITE 200
SUNNYVALE, CA 94085

EXAMINER	
CHEN, KIN CHAN	

ART UNIT	PAPER NUMBER
1765	

DATE MAILED: 06/01/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/998,858	CHOU ET AL.	
	Examiner	Art Unit	
	Kin-Chan Chen	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 May 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *26-49* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *26-43* is/are allowed.

6)☒ Claim(s) *44-49* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 44-49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nguyen et al. (US 6,207,544; hereinafter "Nguyen") in view of Chiu et al. (US 6,333,27; hereinafter "Chiu") and Armacost et al. (US 6,051,504; hereinafter "Armacost") as evidenced by Loewenstein (US 5,741,396) and Demmin (US 6,635,185).

Nguyen teaches a method for fabricating a nitride spacer of a gate structure. A first etch process may be performed using a first etchant gas. The first etch process may be discontinued upon removing the portion of the spacer layer, leaving a thin spacer layer. The endpoint detection method may be used to detect a removal of a portion of a spacer layer having a specific thickness. A second etch process may be performed using a second etchant gas. The second etch process may be configured to remove the thin spacer layer. The second etch process may be discontinued when the second etch process has continued for a predetermined period time. The etching may be performed in-situ. The second etch process is configured to remove the thin spacer layer, leaving the spacer for the gate structure (col. 5, lines 10-17, col. 6, lines 28-40).

Nguyen teaches that the endpoint of etching may be determined **using traditional optical spectrometers** (col. 6, lines 10-12). The claimed invention differs from Nguyen by specifying using interferometry for first etch endpoint detection and using non-interferometry for second etch endpoint detection. However, they are common methods for endpoint detection in dry etching process. In a method of multi-step plasma etch method, Chiu teaches using first plasma etch method and using first detection apparatus (such as interfermetry) to partially etch a microelectronic layer and employing second plasma etch employing a second detection apparatus (such as plasma / optical emission spectroscopy, so-called non-IEP) in order to accurately determine the endpoint of plasma etching, measure /control the thickness (abstract, col. 2, lines 44-66; col. 12, lines 23-28). Hence, it would have been obvious to one with ordinary skilled in the art to use said two-step etching and endpoint detection of Chiu in the process of Nguyen because Chiu teaches that to do so would accurately determine the endpoint of plasma etching, measure /control the thickness. Furthermore, it would have been obvious to one with ordinary skilled in the art to use commonly used endpoint detection methods in the plasma etching process when required, see Maydan et al. (US 4,618,262) and Gardner et al. (US 5,912,188) as evidences in the record for the commonly used interferometry and non-interferometry (non IEP) methods for etching endpoint detection. Unlike the claimed invention, the combined Nguyen and Chiu doesn't teach the claimed etchant. In a method of etching silicon nitride, Armacost teaches that the etchant of C_2F_6, CH_2F_2, and O_2 may be used to etch silicon nitride layer from a multiplayer structure in order to etch high aspect ratio silicon nitride and avoid

loss of image integrity (abstract; col. 2). Hence, it would have been obvious to one with ordinary skilled in the art to use the etchant of Armacost in the process of the combined prior art so as to etch high aspect ratio silicon nitride and avoid loss of image integrity.

As to dependent claim 47, with the interferometry method, It would have been obvious to one with ordinary skilled in the art to determine the thickness of an etch depth during the etch operation implementing the distance between consecutive maximum intensities.

The above-cited claims differ from the combined prior art of Nguyen, Chiu, and Armacost by specifying various compositions /concentration (**such as percentages of volume of etchants**). However, same were known to be **result effective variables** and commonly determined by routine experiment. The process of conducting routine experimentations so as to produce an expected result is obvious to one of ordinary skill in the art.). A person having ordinary skill in the art would have found it obvious to modify the combined prior art by performing routine experiments (by using various compositions/ concentrations) to obtain optimal result. See Loewenstein (US 5,741,396; col.8, lines 3-12 and Figures) and Demmin (US 6,635,185; Col. 7, lines 5-25) in the record as evidences.

3. Claims 44-49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yu et al. (US 6,277,700; hereinafter "Yu") in view of Chiu et al. (US 6,333,27; hereinafter

"Chiu") and Armacost et al. (US 6,051,504; hereinafter "Armacost") as evidenced by Loewenstein (US 5,741,396) and Demmin (US 6,635,185).

Yu teaches a method for fabricating a nitride spacer of a gate structure. A first etch process may be performed using a first etchant gas. The first etch process may be discontinued upon removing the portion of the spacer layer, leaving a thin spacer layer. The endpoint detection method may be used to detect a removal of a portion of a spacer layer having a specific thickness. A second etch process may be performed using a second etchant gas. The second etch process may be configured to remove the thin spacer layer. The second etch process may be discontinued when the second etch process has continued for a predetermined period time. The etching may be performed in-situ. The second etch process is configured to remove the thin spacer layer, leaving the spacer for the gate structure (col.1, lines 64 through col. 2, lines 60).

Yu teaches that the endpoint of etching may be determined with endpoint detection (col. 2, lines 58-59). The claimed invention differs from Yu by specifying using interferometry for first etch endpoint detection and using non-interferometry for second etch endpoint detection. However, they are common methods for endpoint detection in dry etching process. In a method of multi-step plasma etch method, Chiu teaches using first plasma etch method and using first detection apparatus (such as interfermetry) to partially etch a microelectronic layer and employing second plasma etch employing a second detection apparatus (such as plasma / optical emission spectroscopy, so-called non-IEP) in order to accurately determine the endpoint of plasma etching, measure / control the thickness (abstract, col. 2, lines 44-66; col. 12, lines 23-28). Hence, it would

have been obvious to one with ordinary skilled in the art to use said two-step etching and endpoint detection of Chiu in the process of Yu because Chiu teaches that to do so would accurately determine the endpoint of plasma etching, measure / control the thickness. Furthermore, it would have been obvious to one with ordinary skilled in the art to use commonly used endpoint detection methods in the plasma etching process when required, see Maydan et al. (US 4,618,262) and Gardner et al. (US 5,912,188) as evidences in the record for the commonly used interferometry and non-interferometry methods for etching endpoint detection. Unlike the claimed invention, the combined Yu and Chiu doesn't teach the claimed etchant. Armacost teaches that the etchant of C_2F_6, CH_2F_2, and O_2 may be used to etch silicon nitride layer from a multiplayer structure in order to etch high aspect ratio silicon nitride and avoid loss of image integrity (abstract; col. 2). Hence, it would have been obvious to one with ordinary skilled in the art to use the etchant of Armacost in the process of the combined prior art so as to etch high aspect ratio silicon nitride and avoid loss of image integrity.

As to dependent claim 47, with the interferometry method, It would have been obvious to one with ordinary skilled in the art to determine the thickness of an etch depth during the etch operation implementing the distance between consecutive maximum intensities.

The above-cited claims differ from the combined prior art of Yu, Chiu, and Armacost by specifying various compositions /concentration (**such as percentages of volume of etchants)**. However, same were known to be **result effective variables** and commonly determined by routine experiment. The process of conducting routine

experimentations so as to produce an expected result is obvious to one of ordinary skill in the art.). A person having ordinary skill in the art would have found it obvious to modify the combined prior art by performing routine experiments (by using various compositions/ concentrations) to obtain optimal result. See Loewenstein (US 5,741,396; col.8, lines 3-12 and Figures) and Demmin (US 6,635,185; Col. 7, lines 5-25) in the record as evidences.

Changes in compositions, temperature, concentrations, or other process conditions of a process do not impart patentability unless the recited ranges are critical (i.e., they produce a new and unexpected result that differs in kind and not merely in degree from the result of the prior art). *In re Woodruff*, 16USPQ2d 1934,1936 (Fed. Cir.1990); *In re Hoeschele*, 406 F.2d 1403, 160 USPQ 809; *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). MPEP 2144.05 II.

Conclusion

4. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Maydan et al. (US 4,618,262) teach the commonly used interferometry method for etching endpoint detection. Gardner et al. (US 5,912,188) show that four common methods for determining the endpoint of dry etching process including interferometry and optical emission spectroscopy (col. 2, lines 9-16). Rutzke (US 6,122,050) teaches that plasma –optical emission spectrometer is a species of plasma spectrometer (col. 1, lines 35-58). **Loewenstein (US 5,741,396) discloses that**

etch rate and selectivity as function of composition ratio of etchants, also teaches to vary pressure, temperature and gas flow see col.8, lines 3-12 and Figures. Demmin (US 6,635,185; Col. 7, lines 5-25) teaches that one skilled in the art of plasma etching and cleaning may vary type of plasma etching, composition, flow rate, temperature, and pressure accordingly to etch a desired material satisfactorily.

Response to Arguments

5. Applicant's arguments filed May 5, 2005 have been fully considered but they are not persuasive.

Applicant has argued that the combined prior art does not teach the percentage by volume of the second etchant. It is not persuasive. As has been stated in the office action, the composition and flow rates of etchants (which include the volumetric flow ratios of etchants and therefore perchetage by volume of each etchant as claimed) are result-effective variables. The examiner cited Loewenstein (US 5,741,396) and Demmin (US 6,635,185) as evidences to show the composition and flow rates of etchants (which include the volumetric flow ratios of etchants) are result-effective variables. Applicant has not acknowledged or commented on that. Loewenstein (US 5,741,396) and Demmin (US 6,635,185) simply show the composition and flow rates of etchants (which include the volumetric flow ratios of etchants) are recognized to be result-effective variables in the art of dry (plasma) etching, and is obvious to one with ordinary skilled in to determine same through routine experimentation. See MPEP 2144.03 and MPEP

2144.05IIA. The principle is not limited to any particular structures or type of etchants. What is critical is the relationship between etching characteristics and etching parameters.

Applicant has argued that Armacost does not teach removing the nitride layer form the substrte surface. It is not persuasive. In fact, Armacost teaches that the etchant of C_2F_6, CH_2F_2, and O_2 may be used to etch silicon nitride layer from a multiplayer structure / semiconductor wafer (so-called substrate) in order to etch high aspect ratio silicon nitride and avoid loss of image integrity, see abstract; col.1, lines 8-10.

Allowable Subject Matter

6. Claims 26-43 are allowed.

Conclusion

7. THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kin-Chan Chen whose telephone number is (571) 272-1461. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

May 26, 2005

K. C Chen

Kin-Chan Chen
Primary Examiner
Art Unit 1765

K-C C